



MARKSCHEME

May 2013

BIOLOGY

Higher Level

Paper 3

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Subject Details: Biology HL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **TWO** of the Options [**2 % 20 marks**].

Maximum total = [**40 marks**]

1. A markscheme often has more marking points than the total allows. This is intentional.
2. Each marking point has a separate line and the end is shown by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets () in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect).
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking indicate this by adding **ECF** (error carried forward) on the script.
10. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

Option D — Evolution

- D1.** (a) 11° (accept answers in the range of 10.5° to 11.5°) [1]
- (b) 6° (accept answers up to 7°) (working not required) [1]
- (c) mean/average of Swartkrans less than larvae;
range of Swartkrans less than larvae;
no overlap between the two in terms of widths of scratch marks / widest Swartkrans
less width than the narrowest larvae; [2 max]
Do not accept answers stating numerical values only.
- (d) *from the photograph:*
(*A. robustus*) ate termites because the pattern of scratch marks on the tool are of
similar angle;
from the graph:
(*A. robustus*) ate termites because the ranges of widths/means of angles/widths are
more similar; [2]
- (e) 1.4 to 1.8 million years ago (accept answers within this range) [1]
- D2.** (a) all of the genes/alleles in an interbreeding population [1]
- (b) population is large;
mating is random;
constant allele frequency over time / no migration/emigration/immigration/ gene
flow;
no allele-specific mortality/natural selection/mutation; [2 max]
- (c) sympatric speciation occurs in the same geographic location/place whereas
allopatric speciation occurs in different geographic locations [1]
- (d) polymorphism is when there are different phenotypes/alleles of the same gene in
the same population/gene pool;
it is balanced when these phenotypes exist over several generations / allele
frequencies remain constant;
homozygotes/example have disadvantage (in certain environments);
heterozygotes/example have a greater probability of surviving malaria/ advantage
where malaria prevails; [3 max]

D3. *phylogeny: [4 max]*

the amino acid sequence/structure of proteins is determined genetically/based on DNA structure;

protein must be common to organisms being classified;

organisms with similar amino acid/peptide/protein sequences are likely to be closely related;

organisms with similar amino acid/peptide/protein sequences are likely to have a common ancestor;

hemoglobin commonly used to show phylogeny / other example;

evolutionary clock: [4 max]

mutations in genes change the sequence of amino acids in proteins;

mutations occur randomly;

constant mutation rate over a long period of time;

the more differences in the amino acid sequence, the longer since they
had a common ancestor/greater evolutionary distance;

{ (accept
converse)

[6 max]

Option E — Neurobiology and behaviour

- E1.** (a) 2.6 mg (*units required*) (*accept answers in the range of 2.5 mg to 2.7 mg*) **[1]**
No working required.
- (b) both foraged more after starvation;
 black goby increased the amount of food foraged more than the sand goby; **[2]**
- (c) (i) predator present causes both to forage for less food;
 fed black gobies showed little change in foraging (with predator present);
 starved gobies foraged more than fed gobies (with predator present);
 relative foraging remains similar between the two species / black goby
 always forages less than sand goby; **[2 max]**
- (ii) gobies may feed on smaller mud shrimps when predator present;
 gobies may hide rather than forage when predator present / gobies may feed
 less efficiently if they are watching out for predators;
 predator may also eat shrimp so less for gobies;
 if predator eats gobies the total mass of food foraged is less / *OWTTE*; **[1 max]**

- E2.** (a) (i) I: pinna;
II: ear drum / tympanic membrane; } (both needed) [1]

- (ii) cilia/hair/hair bundles of hair cells vibrate with (cochlear) liquid/fluid movement [1]

- (b) optic nerves from right eye and left eye meet/cross at the (optic) chiasma;
right brain (hemisphere) processes information from the left visual field from both eyes / *vice versa*;
processing of slight differences in images enables (brain) perception of depth and size; [2 max]

Do not award marks for answers suggesting that all impulses from the left eye pass to the right side of the brain and vice versa.

(c)

Part of Brain		Function	
hypothalamus	I	V	memory centre
medulla oblongata	II	I	homeostasis
cerebellum	III	IV	secretes hormones regulating body functions
pituitary gland	IV	III	coordinates balance
cerebral hemispheres	V	II	controls breathing

[2 max]

*Award [1] for any **two** correct responses.*

- (d) pupil reflex is controlled by autonomic nervous system/brain/ } (do not accept
midbrain; } medulla)
light shone into the eye would normally cause pupil contraction;
no pupil reflex indicates that synapses are not functioning;
can indicate brain death but not necessarily / OWTTE; [2 max]

- E3.** cocaine is an excitatory drug;
effect on synapses that use dopamine as neurotransmitter;
dopamine affects reward/motivation and pleasure pathways in the brain;
dopamine (molecules) are released into the synapse;
attach to receptors of the postsynaptic membrane;
dopamine is then taken up again/reabsorbed by presynaptic membrane/dopamine
receptors/transporters;
cocaine prevents reabsorption of dopamine by the presynaptic membrane;
so dopamine remains in the synapse/continues to stimulate the postsynaptic neuron and
the effects of pleasure continue;
(in long-term brain responds by) lower production of dopamine causing behavioral
changes/addiction/depression; [6 max]

Option F — Microbes and biotechnology

- F1.** (a) 55°C (*units required*) [1]
- (b) 30 litres (*accept answers in the range of 28.8 to 30.0 litres*) [1]
Working not required.
- (c) good because it kills/is free of bacteria;
no bacteria between 80° and 60° even at higher flow rates;
not good as it would use too much energy/be expensive to heat water; [2 max]
- (d) the slower the flow rate, the lower the temperature [1]
- (e) *implications:*
kills bacteria/most pathogens by heating food/liquids to specific/high/ 60°–72° temperature;
(usually pasteurization temperature) does not alter the taste/quality/chemical structure;
limitations:
may not kill heat-resistant/all bacteria;
requires immediate cooling to prevent (further) microbial growth; [2 max]
- F2.** (a) single or double stranded;
DNA or RNA; [2]
- (b) Gram stain permits classifying bacteria according to structure of their cell walls;
Gram-positive bacteria have thick peptidoglycan layer and Gram-negative a thin layer with an outer membrane;
giving different pathogenic/resistance properties;
Gram-positive bacteria appear purple / Gram-negative pink/reddish; [2 max]
- (c)
- | | <i>chemoautotroph</i> | <i>chemoheterotroph</i> |
|----------------------|---------------------------|----------------------------|
| <i>energy source</i> | chemical reactions/energy | chemical reactions/energy; |
| <i>carbon source</i> | inorganic compounds | organic compounds; |
- Award [1] for any two correct responses.* [2]
- (d) heterocyst / nitrogen fixing cell [1]

F3. *processes:*

generated from waste animal/plant material;
material placed in a digester/fermenter/bioreactor;
bacteria/microorganisms convert organic waste into organic acids and alcohol;
all processes are anaerobic / fermentation;
other bacteria act on waste to convert to acetate/carbon dioxide and hydrogen;
methanogenic bacteria produce methane anaerobically;
from acetate/carbon dioxide and hydrogen;

conditions:

digester needs to be damp/warm for reactions to occur;
pH conditions not too acidic / in absence of oxygen;
temperature rise needs to be controlled to prevent killing the useful bacteria;

[6 max]

Option G — Ecology and conservation

- G1.** (a) rest **[1]**
- (b) 75(%) (*accept answers in the range of 72 to 78%*) **[1]**
- (c) comparison for one of the behaviours (rest/alert/flight) between the control group and the falcon group for weeks 1 to 5;
 comparison for one of the behaviours (rest/alert/flight) between the control group and the falcon group for weeks 6 to 10;
 comparison for one of the behaviours (rest/alert/flight) between weeks 1 to 5 for the control group and weeks 6 to 10 for the falcon group / converse;
 comparison between the proportions/differences of overall behaviours for the control group with those for the falcon group for weeks 1 to 5/weeks 6 to 10 / overall change in all groups over time; **[3 max]**
*Award **[1 max]** for a correct comparison for each marking point. Do not award marks for a comparison between the control group only or the falcon group only.*
- (d) falcon group has closer values (in all categories) to control in weeks 6 to 10;
 falcon group has more rest in weeks 6 to 10 than in weeks 1 to 5 so indication for more nesting;
 insignificant/no long-term effect as gulls seem to become accustomed to falcons / trend is likely to continue / *OWTTE*; **[2 max]**

G2. (a) *in situ* within the organism's natural environment whereas *ex situ* taken out of natural environment / *OWTTE* [1]

(b) record size of catches from fishing boats;
capture, tagging, releasing and recapturing fish / Lincoln index;
sample fishes with trawling nets;
estimate population with echo sounder/sonar/fish finder; [2 max]
Award marks only for the first two methods if more than two written.

(c)

<i>characteristic</i>	<i>K- or r-strategy</i>
<i>few offspring</i>	<i>K;</i>
<i>short life span</i>	<i>r;</i>
<i>late maturity</i>	<i>K;</i>
<i>show parental care</i>	<i>K;</i>

[2]

Award [1] for two correct responses.

(d) name of species and what caused it to become extinct (*both needed*) [1]
*The named species must be **extinct** and not endangered.*

eg:

passenger pigeon (became extinct when) hunted as a source of food

(e) it allows comparison of the biodiversity in two different (local) communities/
abiotic conditions;
it allows comparison of the biodiversity at two different times in the same
community / longitudinal study / change in the environment; [1 max]

G3. named example of chemical;
chemical absorbed by organism low in the food chain;
chemical not excreted/accumulates in body fat;
organism eaten by other organisms in higher trophic levels;
causing it to be much more concentrated at each trophic level;
substance accumulates in species at the highest trophic level;
may reach toxic levels;
named example of species at top of food chain;
harmful effect caused by the chemical; [6 max]
Award [5 max] if specific name of chemical is not given or chemical does not bioaccumulate.

eg:

mercury;

absorbed by small fish;

(mercury) not excreted (by small fish) / accumulates in (small fish) tissues;

eaten by tuna;

(mercury) becomes more concentrated at each trophic level;

(mercury) accumulates in species at the highest trophic level;

may reach toxic levels;

humans may eat the tuna;

leads to brain damage / birth defects / mercury poisoning;

Option H — Further human physiology

- H1.** (a) (children) with asthma have lower lung function / (children) without asthma have higher lung function [1]
- (b) 7% (*units needed*) (*accept answers in the range of 6% to 8%*) [1]
- (c) female lung function higher than male;
males and females both better (lung function) without asthma;
males with asthma have a greater reduction in lung function / greater difference between males and females with asthma than without asthma; [2 max]
- (d) asthma causes constriction/congestion/inflammation of the airways/breathing tubes/bronchi/bronchioles;
units measure ability to exhale quickly/efficiently which could indicate asthma; [2]
- (e) allergens / pollutants / pollen / dust mites / cold (temperature) / viral illness / exercise / anxiety/stress / hereditary [1]
- H2.** (a) insulin / growth hormone / glucagon / ADH / FSH / LH / other [1]
- (b) pepsin secreted as pepsinogen / inactive precursor;
activated by stomach acidity/low pH/HCl; [2]
- (c) bile emulsifies/*OWTTE* lipids so enzymes can act on them [1]
- (d) hemoglobin from the red blood cells is absorbed/phagocytosed in the liver/by Kupffer cells;
hemoglobin is broken down into heme and globin groups;
iron is removed from the heme groups;
(residue from) heme becomes bilirubin/bile pigment (in hepatocytes); [3 max]
- H3.** during diastole the heart muscles/atria/ventricles are relaxed;
blood enters the atria;
during atrial systole the atria contract and blood moves into the ventricles;
pressure (in ventricles) causes bicuspid/tricuspid/AV valves to close;
(this) closing of valves causes first heart sound;
during ventricular systole the ventricles contract causing blood to flow to aorta/pulmonary artery/arteries/out of heart;
semilunar valves close so blood does not return to the ventricles;
this causes the second heart sound;
blood leaving atria/ventricles during contraction is caused by increased pressure which reduces volume; [6 max]
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